

## CLAIMS:

*Sub A* *urethane* *active* *polymer* *isobutene* *isobutylene* *copolymer*

1. An adhesive composition comprising a thermoplastic high molecular weight polymer (A) containing a crosslinkable functional group as a pendant group and substantially free of carbon-carbon double bonds with a hydrogen radical at its allyl position in the main chain, a water-soluble high polymer (B) and a compound (C) having a structure with methylene linked aromatics having a polar functional group.
2. An adhesive composition comprising a thermoplastic high molecular weight polymer (A) containing a crosslinkable functional group as a pendant group and substantially free of carbon-carbon double bonds with a hydrogen radical at its allyl position in the main chain, a water-soluble high polymer (B) and a compound (C) having a structure with methylene linked aromatics having a polar functional group, and further containing at least one component selected from the group consisting of an aliphatic epoxide compound (D), a metal salt (E), a metal oxide (F), a rubber latex (G) and a benzene derivative (H) having two or more (blocked) isocyanate groups.
3. An adhesive composition comprising a thermoplastic high molecular weight polymer (A) containing a crosslinkable functional group as a pendant group and substantially free of carbon-carbon double bonds with a hydrogen radical at its allyl position in the main chain and an aqueous urethane compound (I) obtained by reacting an organic polyisocyanate ( $\alpha$ ) having a structure with methylene linked aromatics, a compound ( $\beta$ ) having plural active hydrogens, and a thermally dissociatable blocking agent ( $\gamma$ ) for an isocyanate group.
4. An adhesive composition comprising a thermoplastic high molecular weight polymer (A) containing a crosslinkable functional group as a pendant group and substantially free of carbon-carbon double bonds with a hydrogen radical at its allyl position in the main chain and an aqueous urethane

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compound (I) obtained by reacting an organic polyisocyanate ( $\alpha$ ) having a structure with methylene linked aromatics, a compound ( $\beta$ ) having plural active hydrogens, and a thermally dissociatable blocking agent ( $\gamma$ ) for an isocyanate group, and further containing at least one component selected from the group consisting of an aliphatic epoxide compound (D), a metal salt (E), a metal oxide (F), a rubber latex (G) and a benzene derivative (H) having two or more (blocked) isocyanate groups.

5. An adhesive composition comprising a water-soluble high polymer (B) and an aqueous urethane compound (I) obtained by reacting an organic polyisocyanate ( $\alpha$ ) having a structure with methylene linked aromatics, a compound ( $\beta$ ) having plural active hydrogens and a thermally dissociatable blocking agent ( $\gamma$ ) for an isocyanate group.

6. An adhesive composition comprising a water-soluble high polymer (B) and an aqueous urethane compound (I) obtained by reacting an organic polyisocyanate ( $\alpha$ ) having a structure with methylene linked aromatics, a compound ( $\beta$ ) having plural active hydrogens and a thermally dissociatable blocking agent ( $\gamma$ ) for an isocyanate group and further containing at least one component selected from the group consisting of an aliphatic epoxide compound (D), a metal salt (E), a metal oxide (F), a rubber latex (G) and a benzene derivative (H) having two or more (blocked) isocyanate groups.

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7. An adhesive composition according to any one of claims 1 to 4, wherein the thermoplastic high molecular weight polymer (A) is a water-dispersible polymer.

8. An adhesive composition according to any one of claims 1 to 4 and 7, wherein the thermoplastic high molecular weight polymer (A) has a weight average molecular weight of not less than 10,000.

9. An adhesive composition according to any one of claims 1 to 4, 7 and 8, wherein the crosslinkable functional group in the pendant group of the

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thermoplastic high molecular weight polymer (A) is at least one selected from the group consisting of an oxazoline group, a bismaleimide group, a (blocked) isocyanate group, an epoxy group, an aziridine group, a carbodiimide group, a hydrazino group and an epithio group.

10. An adhesive composition according to any one of claims 1 to 4 and 7 to 9, wherein the thermoplastic high molecular weight polymer (A) is an ethylenically addition polymer containing 2-oxazoline group as a pendant group.

11. An adhesive composition according to any one of claims 1 to 4 and 7 to 10, wherein the main chain of the thermoplastic high molecular weight polymer (A) comprises an ethylenically addition polymer of units derived from a monomer containing substantially one carbon-carbon double bond, and an addition-reactive carbon-carbon double bond derived from conjugated diene monomer is not more than 10% as a composition ratio in the main chain monomer.

12. An adhesive composition according to any one of claims 1 to 4 and 7 to 9, wherein the thermoplastic high molecular weight polymer (A) is a urethane based high molecular weight polymer containing a hydrazino group in its pendant group.

13. An adhesive composition according to any one of claims 1, 2, 5 and 6, wherein the water-soluble high polymer (B) is a water-soluble high polymer containing a carboxyl group.

14. An adhesive composition according to any one of claims 1, 2, 5, 6 and 13, wherein the water-soluble high polymer (B) contains substantially free of carbon-carbon double bond with a hydrogen radical at its allyl position and has a weight average molecular weight of not less than 3,000.

15. An adhesive composition according to any one of claims 1, 2, 5, 6, 13 and 14, wherein the water-soluble high polymer (B) is a (co)polymer contain-

ing an ethylenic unit inclusive of a monomer containing a carboxyl group.

16. An adhesive composition according to any one of claims 1, 2, 5, 6 and 13~15, wherein the water-soluble high polymer (B) is a copolymer containing a maleic anhydride unit and an isobutylene unit, or a derivative thereof.

17. An adhesive composition according to claim 1 or 2, wherein the polar functional group of the compound (C) is at least one functional group selected from the group consisting of (blocked) isocyanate group, epoxy group, hydroxyl group, amino group and carboxyl group.

18. An adhesive composition according to claim 17, wherein the compound (C) is a reaction product of diphenylmethane diisocyanate or polyethylene polyphenyl polyisocyanate and a thermally dissociatable blocking agent for an isocyanate group.

19. An adhesive composition according to claim 17, wherein the compound (C) is a condensate of phenol and formaldehyde, or a modified product thereof.

20. An adhesive composition according to claim 19, wherein the condensate of phenol and formaldehyde is a condensate of resorcine and formaldehyde through novolak reaction, a condensate of chlorophenol and resorcin and formaldehyde, or an epoxy cresol novolak resin.

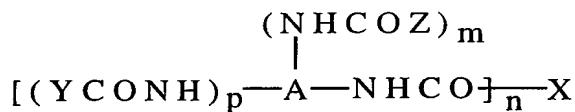
21. An adhesive composition according to claim 17, wherein the compound (C) is an aqueous urethane compound (I) obtained by reacting an organic polyisocyanate ( $\alpha$ ) having a structure with methylene linked aromatics, a compound ( $\beta$ ) having plural active hydrogens and a thermally dissociatable blocking agent ( $\gamma$ ) for an isocyanate group.

22. An adhesive composition according to claim 21, wherein the aqueous urethane compound (I) is an aqueous urethane compound having at least a thermally dissociatable blocked isocyanate group and a hydrophilic

group, and the aqueous urethane compound is a reaction product obtained by (i) reacting an organic polyisocyanate compound ( $\alpha$ ) having a structure with methylene linked aromatics with a compound ( $\beta$ ) having plural active hydrogens to obtain a urethane prepolymer having a free isocyanate group and (ii) treating the urethane prepolymer with a thermally dissociatable blocking agent ( $\gamma$ ) for an isocyanate group and a compound ( $\delta$ ) having at least one active hydrogen and at least one hydrophilic group of anionic and/or nonionic hydrophilic groups.

23. An adhesive composition according to claim 22, wherein the aqueous urethane compound (I) is a reaction product comprising 40-85% by weight of the organic polyisocyanate compound ( $\alpha$ ) having 3-5 isocyanate groups and a molecular weight of not more than 2,000, 5-35% by weight of the compound ( $\beta$ ) having 2-4 active hydrogens and a molecular weight of not more than 5,000, 5-35% by weight of the thermally dissociatable blocking agent ( $\gamma$ ) and 5-35% by weight of the compound ( $\delta$ ), and the thermally dissociatable blocked isocyanate group in the molecular weight of the reaction product is 0.5-11% by weight (converted as NCO = 42).

24. An adhesive composition according to claim 22 or 23, wherein the aqueous urethane compound (I) is represented by the following general formula:



[wherein A is a residue of the organic polyisocyanate compound ( $\alpha$ ), Y is a residue of the thermally dissociatable blocking agent ( $\gamma$ ), Z is a residue of the compound ( $\delta$ ), X is a residue of the compound ( $\beta$ ), n is an integer of 2-4 and p+m is an integer of 2-4 ( $m \geq 0.25$ )].

25. An adhesive composition according to any one of claims 2, 4 and 6, wherein the aliphatic epoxide compound (D) is a compound having two or

more epoxy groups in one molecule.

26. An adhesive composition according to any one of claims 2, 4, 6 and 25, wherein the aliphatic epoxide compound (D) is a reaction product of polyvalent alcohol and epichlorohydrin.

27. An adhesive composition according to any one of claims 2, 4 and 6, wherein the metal salt (E) is a salt of polyvalent metal.

28. An adhesive composition according to any one of claims 2, 4 and 6, wherein the metal oxide (F) is an oxide of polyvalent metal.

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29. An adhesive composition according to claim 1, wherein the adhesive composition contains 2-75% of the thermoplastic high molecular weight polymer (A), 5-75% of the water soluble high polymer (B) and 15-77% of the compound (C) on dry weight.

30. An adhesive composition according to claim 2, wherein when the adhesive composition contains 2-75% of the thermoplastic high molecular weight polymer (A), 5-75% of the water soluble high polymer (B) and 15-77% of the compound (C) on dry weight, it further contains not more than 70% of the aliphatic epoxide compound (D), not more than 50% of the metal salt (E), not more than 50% of the metal oxide (F), not more than 18% of the rubber latex (G) and not more than 50% of the benzene derivative (H).

31. An adhesive composition according to claim 3, wherein the adhesive composition contains 2-75% of the thermoplastic high molecular weight polymer (A) and 15-87% of the aqueous urethane compound (I) on dry weight.

32. An adhesive composition according to claim 4, wherein when the adhesive composition contains 2-75% of the thermoplastic high molecular weight polymer (A) and 15-87% of the aqueous urethane compound (I) on dry weight, it further contains not more than 70% of the aliphatic epoxide compound (D), not more than 50% of the metal salt (E), not more than 50% of

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the metal oxide (F), not more than 18% of the rubber latex (G) and not more than 50% of the benzene derivative (H).

33. An adhesive composition according to claim 5, wherein the adhesive composition contains 5-75% of the thermoplastic high molecular weight polymer (A) and 15-77% of the aqueous urethane compound (I) on dry weight.

34. An adhesive composition according to claim 6, wherein when the adhesive composition contains 5-75% of the thermoplastic high molecular weight polymer (A) and 15-77% of the aqueous urethane compound (I) on dry weight, it further contains not more than 70% of the aliphatic epoxide compound (D), not more than 50% of the metal salt (E), not more than 50% of the metal oxide (F), not more than 18% of the rubber latex (G) and not more than 50% of the benzene derivative (H).

35. An adhesive composition according to any one of claims 1-34, wherein an alkali metal is not more than 2% on dry weight even when it is contained in the adhesive composition.

36. An adhesive composition according to any one of claims 1-35, wherein the adhesive composition has storage moduli  $G'$  of not more than  $10^9$  at  $60^\circ\text{C}$  and a frequency of 10 Hz and not less than  $10^6$  at  $200^\circ\text{C}$  and a frequency of 10 Hz when a dynamic viscoelasticity is measured.

37. An adhesive composition according to any one of claims 1-36, wherein an integrated reaction calorie per 1 g on dry weight of the adhesive composition is not more than 85 J(joule) when the adhesive composition is heat-treated at  $240^\circ\text{C}$  for 30 minutes, cooled to room temperature and 100 parts by dry weight of the adhesive composition is reacted with 10 parts by weight of sulfur at  $160^\circ\text{C}$  for 90 minutes.

38. A resin material characterized by having a surface coated with a layer of an adhesive composition as claimed in any one of claims 1-37.

39. A resin material according to claim 38, wherein a resin of the resin material is a polyester resin, an aromatic polyamide resin or an acrylic resin.

40. A resin material according to claim 39, wherein the polyester resin is polyethylene terephthalate or polyethylene naphthalate.

41. A resin material according to any one of claims 38-40, wherein the resin material is a cord obtained twisting plural filaments, and the cord comprises cable twist and ply twist of the synthetic fiber, in which a twisting coefficient N1 of the ply twist is 0-0.70 and a twisting coefficient N2 of the cable twist is 0.12-0.90 as defined by the following equations (1) and (2).

$$N1 = n1 \times (0.125 \times D1/\rho)^{1/2} \times 10^{-3} \quad (1)$$

$$N2 = n2 \times (0.125 \times D2/\rho)^{1/2} \times 10^{-3} \quad (2)$$

(wherein D1 is an indicated decitex number of the ply twist bundle, D2 is a total indicated decitex number, n1 is the number of ply twist (turns/10 cm), n2 is the number of cable twist (turns/10 cm) and  $\rho$  is a specific gravity of an organic fiber).

42. A resin material according to claim 41, wherein the cord comprises cable twist and ply twist of the synthetic fiber, in which the twisting coefficient of the ply twist is 1300-2500 and the twisting coefficient of the cable twist is 900-1800.

43. A resin material according to any one of claims 41 and 42, wherein the adhesive composition coating the cord is 0.5-6.0% by weight per the cord weight on dry weight.

44. A rubber article characterized by reinforcing with a resin material as claimed in any one of claims 38-43.

45. A pneumatic tire characterized by applying a rubber article as claimed in claim 44 as a rubber member.

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